M 17605X

WX2400-UM-151

LAB COPY

INSTRUCTION MANUAL

for

X-Y RECORDER

WX 2400 SERIES

WESTERN GRAPHTEC

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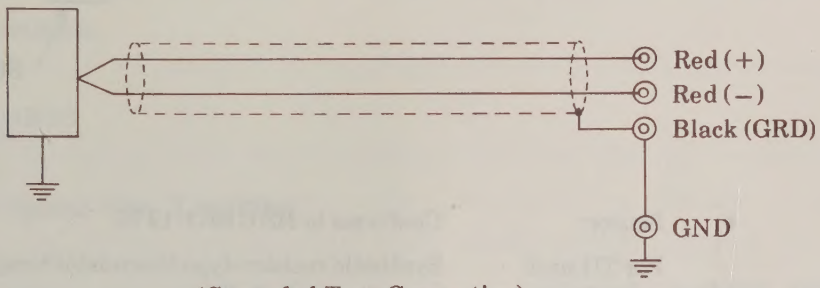
Temperature Unit Connection Method

Notes

1. When using a temperature unit, remove the shorting bar from the voltage-measurement input terminals.
2. The input signal to the temperature unit should always be applied from a special signal conditioner.

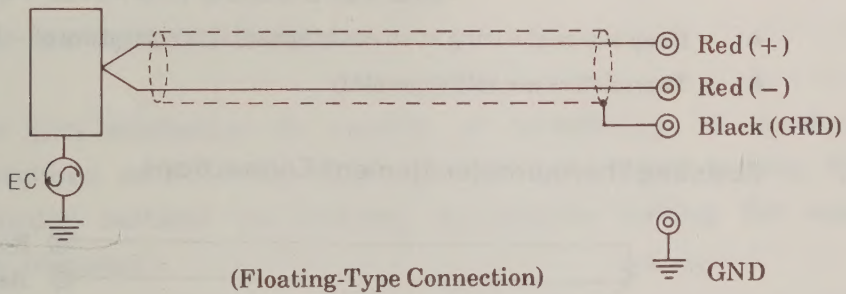
1. Thermocouple Connections

Device under measurement



(Grounded-Type Connection)

Device under measurement



(Floating-Type Connection)

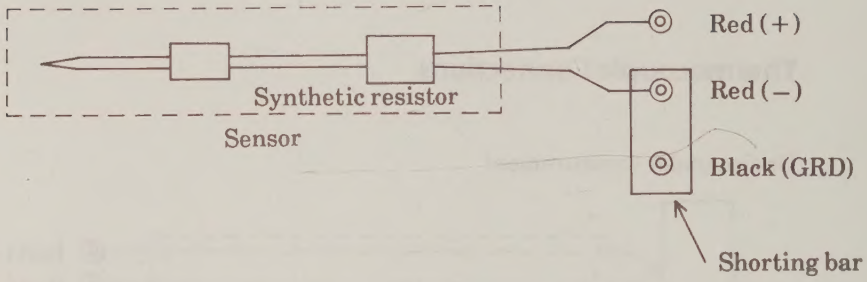
- To enhance temperature-measurement accuracy, use accurate thermocouple and compensation wires.
- Because of the low level of the electromotive force that the thermocouple generates, noise picked up by the thermocouple or input wires may affect the recorded waveform.

  If such noise is a problem (1) use shielded input wires, (2) establish a wiring direction that provides immunity to noise pickup or (3) use twisted pairs for the input wires.

Caution

Take care not to short the red (−) and the black (guard) input terminals of the signal conditioner.

2. Thermistor Connections



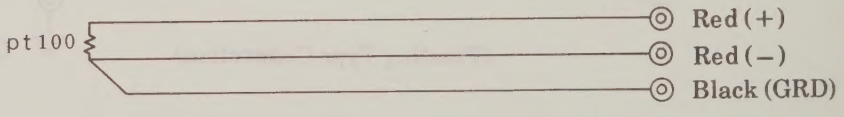
- Sensor: Conforms to JIS C1611-1975.

  For TH unit: Synthetic resistor-type thermistor temperature-measurement element.
  0 to 100°C (0.3%) or THR 0 to 100°C (0.3%)

  For TL unit: Synthetic resistor-type thermistor temperature-measurement element.
  –50 to +50°C (0.3%) or THR –50 to °+50C (0.3%)

- Keep external wiring at an environmental temperature of –10 to +60°C.
- Thermistors are sold separately.

3. Resistive Thermometer Element Connections



Notes

1. If there is a great distance between the detection tip and the resistive temperature-sensing element (100 Ω platinum), use a 3-wire connection to prevent the input-wire resistance from causing measurement errors.
2. Use 3 wires of approximately the same diameter.
3. Take care not to short the red (–) and the black (ground) input terminals.

We would like to express our appreciation for your purchase of this Graphtec A4 Size X-Y recorder. To ensure that you get the most out of your new recorder, we recommend that you read and follow carefully the instructions in this manual.

INTRODUCTION

This recorder is an servo-type A4 size (250 x 180mm) X-Y recorder with a 1- or 2-channel Y axis. It features extremely high speed recording and has the high accuracy and reliability to make it suitable for a wide range of applications.

FEATURES

High-Speed Pen Tracking

A maximum speed of 1.5m/s has been achieved, making this recorder suitable for use in high-accuracy recording of even high-speed events.

Fast Pen Up/Down Response

The pen mechanism is capable of performing 10 up/down operations each second (1-ch pen WX2400 only), making the recorder suitable for plotting applications calling for such pen response.

Wide Range of Preamplifiers Available

To enable the recorder to be used in a wide range of differing applications, 18 types of preamplifiers are available, including 3 high-sensitivity types, 9 temperature units and 5 conversion units.

Time Sweep of Both X and Y Axis

Time sweep is provided as a standard feature, enabling X-T and Y-T recording, in addition to the normal X-Y recording mode.

Continuous Recording Using Roll Paper

Using an optional paper feed mechanism continuous X-T recording and automatically updating X-Y recording are possible using roll paper.

Recording and Control Using External Signals

External signals may be applied at the rear panel to enable X-Y recording (including zero adjustment), servo control, time sweep control paper feed control pen up/down control and other functions.

Compact, Lightweight Design

Measuring 482 x 310 x 124mm and weighing only 10.5 (WX2400-1), this recorder is highly portable.

Easy Maintenance

The internal configuration uses a mother board and modules and lubrication points have been eliminated to further enhance ease of maintenance.

Dust Cover

A dust cover is provided as a standard feature to protect the recorder from dust and other impurities.

BEFORE USING THIS RECORDER

Opening the Carton

When the shipping carton is opened, perform a visual inspection of the recorder and check that all the required accessories have been included (refer to Section 8.3). Should any shortages or damage be discovered, contact to local sales representative.

Installation Location

Avoid the following types of locations.

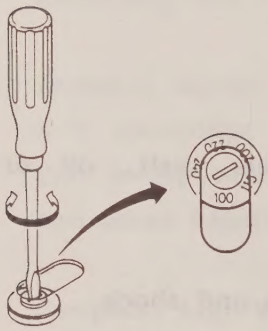
- Locations subject to direct sunlight
- Locations subject to high dust levels, salt, oil or corrosive gases
- Locations subject to excessive vibration and shock
- Locations subject to lightening or other surge voltages

Power Supply

Be sure that the proper line voltage is supplied from a line of sufficient capacity (refer to Section 8.1). A line power source enabling a protective ground to be easily connected should be used.

Handling Trouble

Should abnormal operation or any other abnormal condition be observed during operation, turn off the power immediately and refer to the information on troubleshooting, to be found in Section 5 of this manual.



CAUTION

On the bottom of this recorded is located line voltage selector to enable the recorder to be set up for line voltages other than 100VAC. This selector should be set and checked before turning on and using the recorder.

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1. NAMES AND FUNCTIONS OF THE PARTS

1.1 Names of Parts (Refer to Fig. 1-1 and 1-2)

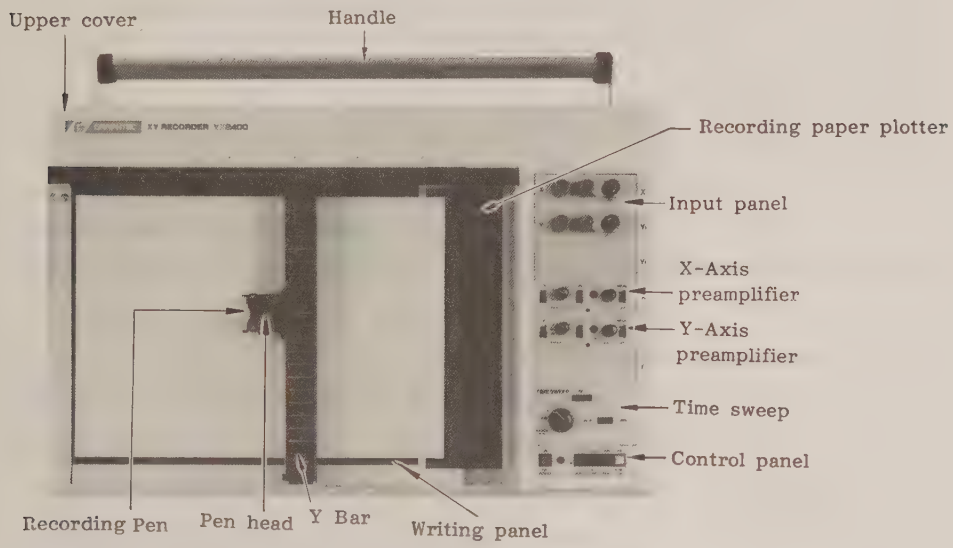


Fig. 1-1 Front view

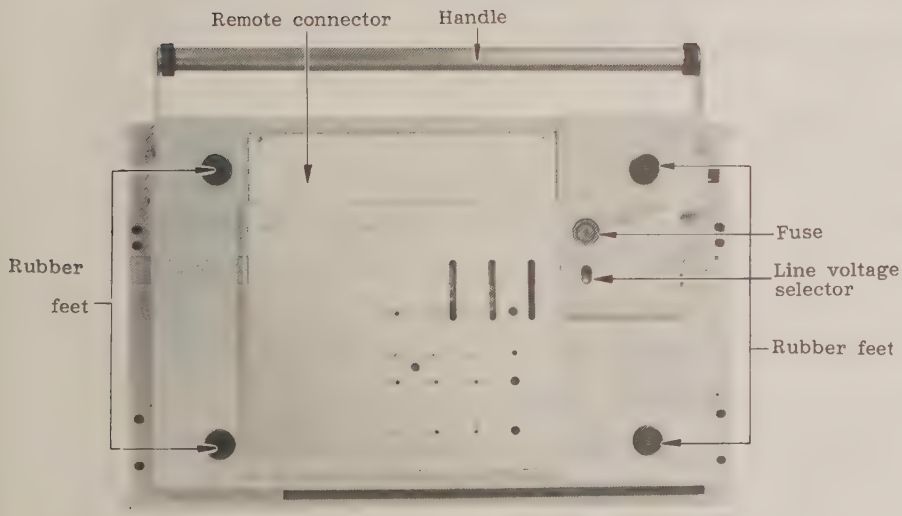


Fig. 1-2 Bottom view

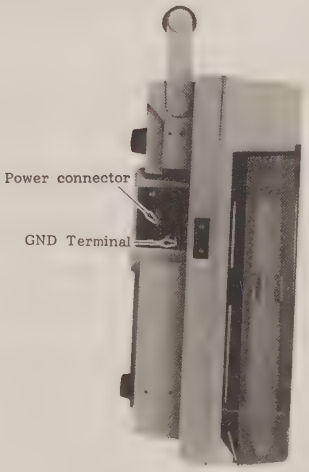


Fig. 1-3 Side view

1.2 Control Panel

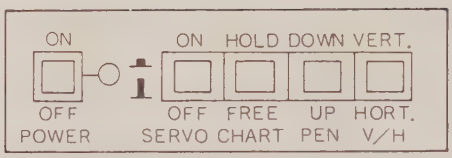


Fig. 1-4 Control panel

Power Switch

This is the recorder's power switch. When pressed in and locked, power is applied and the pilot lamp to the right of the switch lights. Pressing the switch once more turns the power off.

SERVO On/Off Switch

When off, the servo is disconnected, and the servo system will not move. When pressed on and locked, both X-axis and Y-axis servos will operate. Pressing the switch once more turns the servo system off again.

CHART HOLD/FREE Switch

When pressed and locked in the HOLD condition, the writing panel holds the recording paper using static electricity. Pressing the switch once more to place it in the free condition releases the paper. It may take several seconds for the paper to be completely released.

When using the paper feed mechanism, if this switch is in the HOLD condition, the paper feed mechanism will not start.

PEN DOWN/UP Switch

When this switch is pressed into the DOWN condition, the pen is lowered. Pressing it once more raises the pen.

Note that, if the SERVO switch is not ON and the CHART switch is not at HOLD, this switch may not be used to lower the pen. However, when the paper feed mechanism is being used, it is not related to the CHART switch and will operate depending upon paper feed operations. In such cases, leaving the switch in the UP condition will prevent the pen from being lowered. Refer to paper feed mechanism instruction manual for details.

V/H VERT/HORI Switch

This switch is used to compensate the Y-axis transient repsonse, depending upon the installation attitude of the recorder (vertical or horizontal).

When the recorder is used in a vertical attitude, the switch should be set to VERT and when used in a horizontal attitude, it should be set to HORI.

1.3 Input Panels

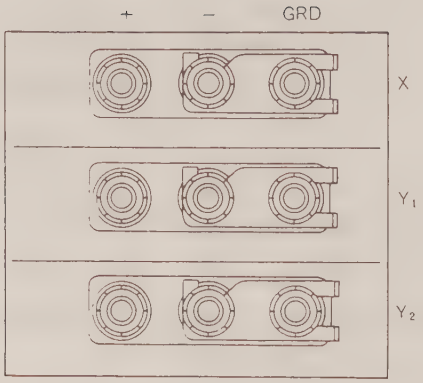


Fig. 1-5 Input panels

Input terminals

The red (+) terminal is the positive side input terminal and the red (-) is the negative side input terminal. These inputs are floating ground type inputs to provide electrical isolation between channels.

Guard terminal

The input cable shield is connected to this terminal, which is connected to the case of preamplifiers which have cases insulated from the recorder case.

Shorting bar

This shorting bar is provided to make a shorting connection between the guard terminal and the negative input terminal. It is used in during normal measurements.

Note: Floating grounds of each input are isolated from one another, to enable mutually independent measurements on each channel.

1.4 Preamplifier Unit (AZ2400)

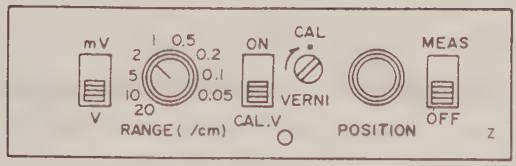


Fig. 1-6 Preamplifier unit panel

The preamplifier is the unit which converts the input signal to the voltage level required by the servo amplifier. This description uses a typical preamplifier, the AZ2400 high-sensitivity DC amplifier unit. For information on other preamplifier units refer to the individual instruction manuals for those preamplifiers.

mV/V Switch

This switch is used to select the units of sensitivity by selecting between 1 and 1/1000 sensitivity ratio.

RANGE (/cm) Switch

This switch is used to select the input voltage per cm of pen deflection. When the mV/V switch is set to mV, the sensitivity is this switch setting in units of mV/cm and when the switch is set to V, the sensitivity is this switch setting in units of V/cm. Thus 18 ranges from 0.5mV/cm to 20V/cm are selectable.

ON/CAL. V Switch

When this switch is set to ON, a switch is made from the signal being measured to a calibration voltage within the amplifier and a fixed deflection (+100mm) is output, regardless of the settings of the mV/V and RANGE switches.

VERNI Adjustment

This is a fine adjustment trimmer for sensitivity and provides continuous adjustment of sensitivity between adjacent ranges. Turning it fully clockwise to the CAL position results in the sensitivity being that sensitivity set on the RANGE switch and the sensitivity at other (midway) position settings can be checked using the deflection that is obtained when the CAL. V switch is set to ON. (For example, if the deflection is 80mm, the sensitivity is 80/100 of the range setting.)

POSITION Adjustment

Turning this control clockwise moves the pen in the positive direction, while turning it counterclockwise moves the pen in the negative direction.

This is used in setting the zero point and the adjustment range is $\pm$300% of fullscale, thus enabling DC components which may be superimposed on the signal being recorded to be compensated for. It is used essentially to record magnified variations on the input signal.

MEAS/OFF Switch

This is the input on/off switch. When set to MEAS, the input signal is used to drive the pen, and when set to off, the input signal is separated and the input of the amplifier is grounded.

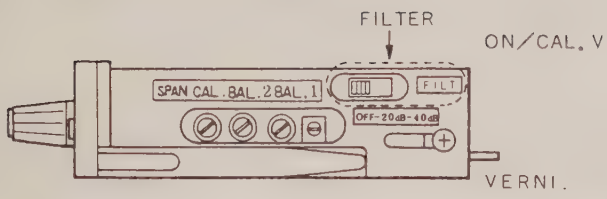
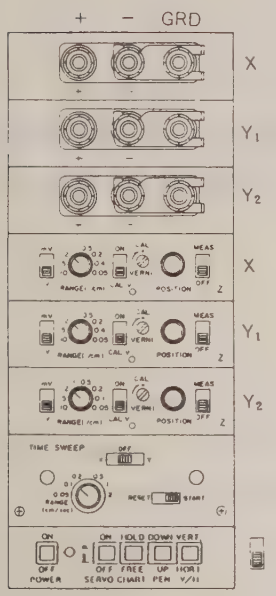


Fig. 1-7 Preamplifier side view

FILTER (See Fig. 1-7)

If the preamplifier unit is pulled out, a switch marked OFF, -20dB, -40dB will be exposed. For recording of signals having such noise components as hum, this switch should be set to -20dB or -40dB, resulting in the noise being cut to 1/10 and 1/100, respectively.



CAUTION (See Fig. 1-8)

1 The positions of the input terminals and preamplifiers for each of the axes is predetermined as shown in Fig. 1-8. Care must, therefore be taken not to insert the modules in the incorrect locations.

2 When pulling out or inserting preamplifiers, always turn the power off first.

Fig. 1-8 Module locations

1.5 Power Supply Connection Section

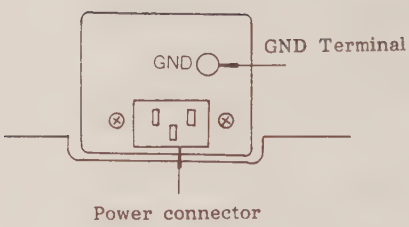


Fig. 1-9

Power Connector

This is a three-pin power connector which includes a protective ground pin (center pin). It is fed power using the power cable provided with the recorder.

Ground Terminal

This terminal is used to ground those metallic parts of the recorder which may be contacted with the hands. It is connected to the AC power connector ground pin and to the case of the recorder.

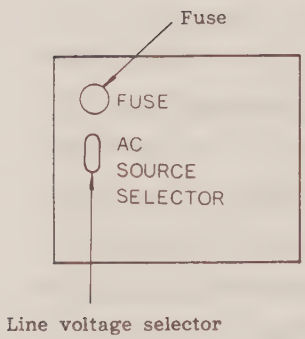


Fig. 1-10

Fuse

This is the AC power fuse, the proper rating of which is 2A for 100VAC and 1A for 200VAC operation.

Power Selector

Before using the recorder, set this line voltage selector to the proper voltage and then connect the power cable.

1.6 Remote Connector

This connector is used when external signals are used to control the recorder. CHART-RENEW, CHART-CLOCK and CHART-STOP are usable when the paper feed mechanism is installed.

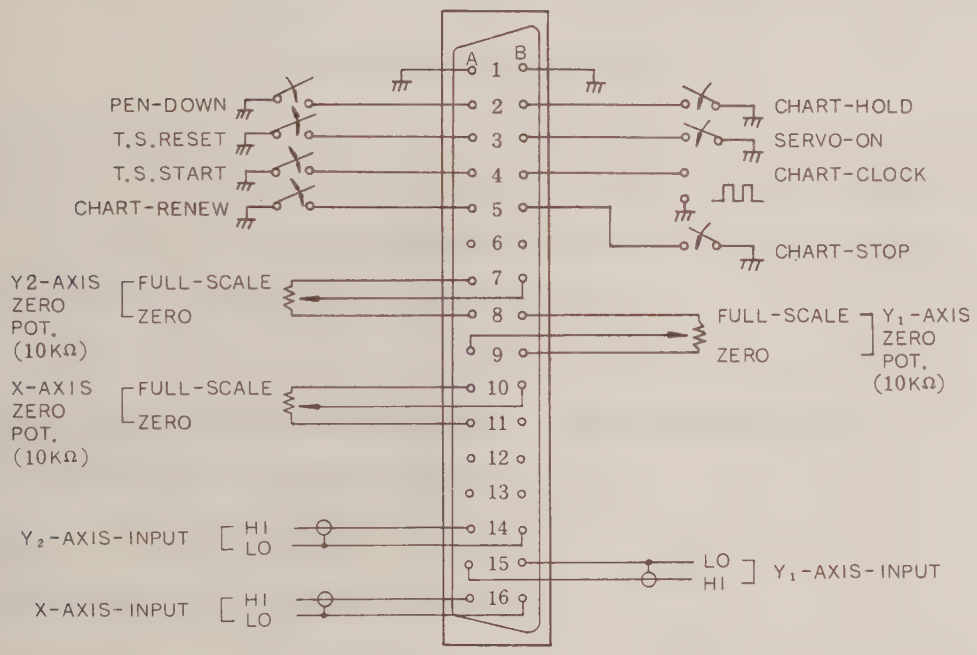


Fig. 1-11 Remote connector pin arrangement

X-, Y_1- and Y_2-AXIS-INPUT

X-AXIS-INPUT
Y_1-AXIS-INPUT
Y_2-AXIS-INPUT

These are the input pins for X, Y_1 and Y_2. They are connected in parallel with the front panel terminals to the preamplifiers.

Connection to each of these is made using a two-wire shielded cable, with the shield being connected to (-) side.

X-, Y_1- and Y_2-AXIS ZERO-POT.

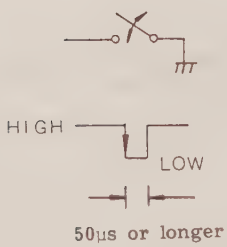
X-AXIS ZERO-POT.
Y_1-AXIS ZERO-POT.
Y_2-AXIS ZERO-POT.

These are the pins used to make connections to the external zero setting trimmers for X, Y_1 and Y_2.

10kΩ potentiometer should be used.

These potentiometers interact with the preamplifier position adjustments.

CHART-RENEW



This is the chart renew signal input for use when the paper feed mechanism is installed. The renew operation feeds the paper to remove a recording which is completed and ready the recorder for another recording.

Contact signal:	Instantaneous short to ground causes RENEW.
TTL Signal:	Instantaneous low level causes RENEW.

This signal is used with the paper feed mechanism MODE dial in the STOP position. Note that when the remote CHART-STOP is enabled, RENEW is not performed.

CHART-STOP

When using the paper feed mechanism, this signal input is used to stop paper feed.

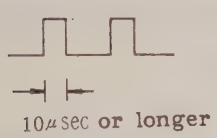
Contact signal: Shorting to ground stops feed.

TTL Signal: Low level stops feed.

This signal input operates in parallel with the paper feed mechanism's STOP switch.

CHART-CLOCK

When using the paper feed mechanism, this input pin may be used to feed the paper using an externally applied pulse signal. It is used with the paper feed mechanism's MODE dial in the EXT. position.



A pulse signal of frequency 2000 pulses per second (corresponding to 50mm/s) or lower is input. Note, however, that if the CHART-STOP is enabled, paper will not feed.

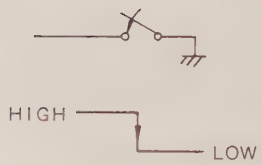
SERVO-ON

This input pin is used to turn the servo system on and off using an external signal. It operates in parallel with the SERVO switch on the control panel.

Contact signal: Short to ground turns servo system ON.

TTL Signal: Low level turns servo system ON.

CHART-HOLD



This input pin is used to control the recording paper HOLD/FREE mode selection using an external signal. It operates in parallel with the CHART switch on the control panel.

Contact signal: Short to ground enables the recording paper HOLD condition.

TTL Signal: Low level enables the recording paper HOLD condition.

Note that when the paper feed mechanism is installed, CHART-HOLD remote operation is disabled.

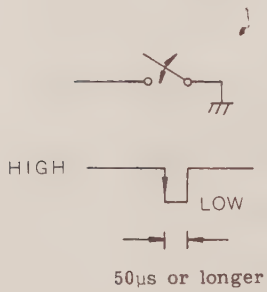
PEN-DOWN

This input pin is used to control the pen up/down movement using an external signal. In operates in parallel with the PEN switch on the control panel.

Contact signal: Short to ground lowers pen.

TTL Signal: Low level lowers pen.

T.S. START



This input pin is used to start the time sweep using an external signal.

Contact signal: Instantaneous short to ground starts the time sweep.

TTL Signal: Instantaneous low level starts the time sweep.

T.S. RESET

This input pin is used to reset the time sweep midway during a sweep using an external signal.

Contact signal: Instantaneous short to ground resets sweep.

TTL Signal: Instantaneous low level resets sweep.

CAUTION: The remote time sweep control signals T.S. START and T.S. RESET have priority over the time sweep panel controls.

Therefore:

- Even if the time sweep panel is in the RESET condition, the time sweep will start if the T.S. START signal is input.
- Even if the time sweep panel is in the START condition, the time sweep will be reset if the T.S. RESET signal is input.

2. CHARACTERISTICS OF THE RECORDER PARTS

This section will serve to provide a working acquaintance with the characteristics of such recorder components as the pens, recording paper, filter and servo system before actually using the recorder.

2.1 Recording Pens

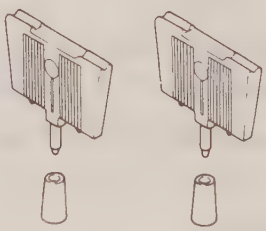


Fig. 2-1

Throw-away fiber tip pens are used in this recorder. When using the specified type of graph paper, the following characteristics and conditions apply.

1 Approximately 600m of straight-line recording is possible.

2 Pen left of 10 times a second can be tolerated.

3 The line width at the beginning of use is approximately 0.3mm.

4 If the pen is to be left in the raised position for a long period, always cover with the pen cap.

2.2 Recording Paper

Recording paper exhibits expansion and contraction in response to changes in humidity. Care should be taken, therefore, when making recordings at high temperatures and humidity. While the figure below illustrates data for the special roll paper used with this recorder, commercially available loose paper will exhibit even greater expansion and contraction.

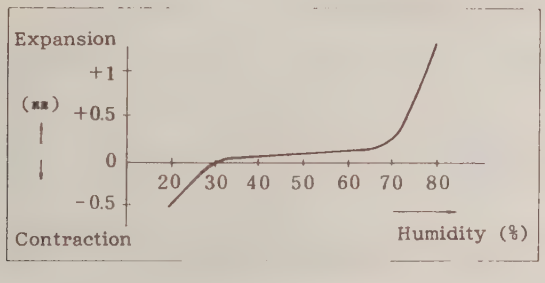


Fig. 2-2

2.3 Filter

Fig. 2-3 illustrates the effect of setting the filter characteristics to -20dB and -40dB on the elimination of noise components.

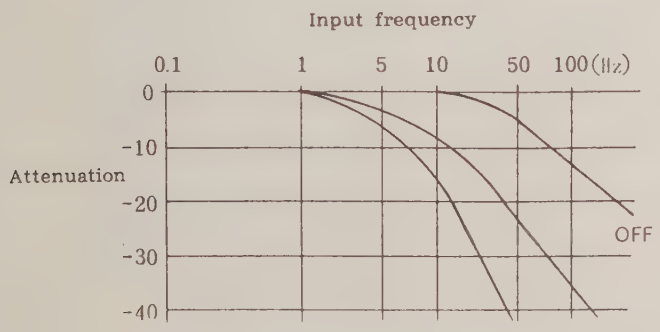


Fig. 2-3

2.4 Servo Frequency Response

Fig. 2-4 and 2-5 show the servo frequency response of the X axis and Y axis, respectively, with a sinewave signal input (typical WX2400 response).

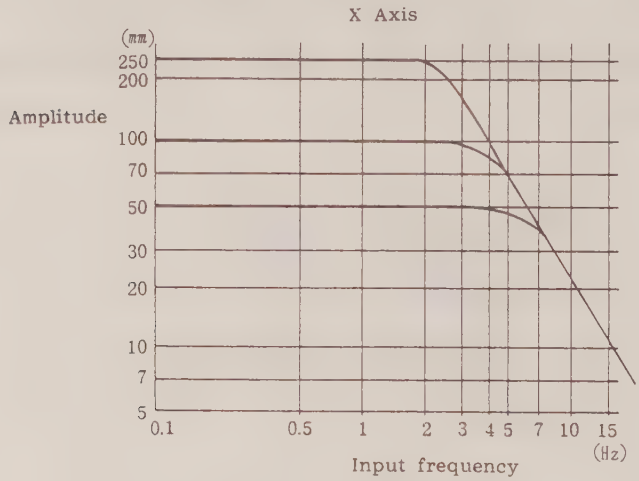


Fig. 2-4 X-Axis sinewave frequency response

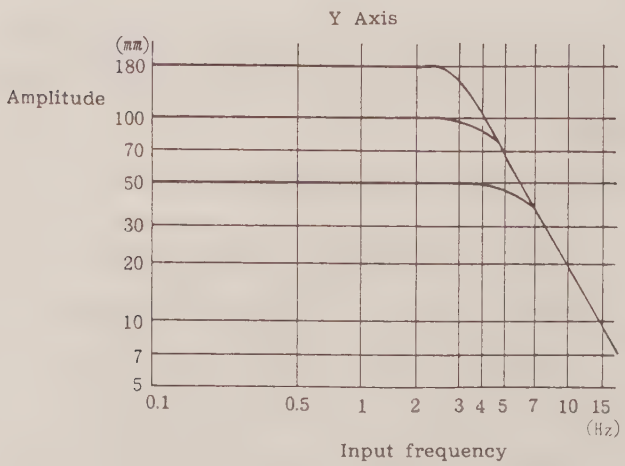


Fig. 2-4 Y-Axis sinewave frequency response

3. OPERATION (Preparation for Measurement)

3.1 Connection of Power Supply

Fig. 3-1

Connect the power supply by following the procedure below.

1 Turn all of the switches on the control panel OFF.

2 Set the preamplifier MEAS/OFF switches to OFF

3 Insert the AC power cable provided with the recorder into the power connector.

4 Connect the protective ground terminal (GND) to a ground.

3.2 Connections of Signal Inputs

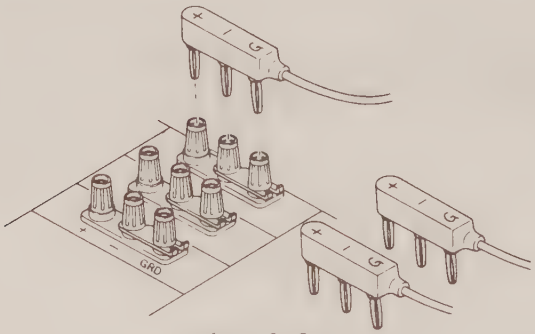


Fig. 3-2

In general, input signals will be connected using the input cables provided with the recorder. These are plugged into the input panel as shown in Fig. 3-2, so that the red lead is connected to (+) signal side, the white lead to the (-) signal side and the shield to the guard terminal. The procedure for connection of the input signals is as follows.

1 Set the MEAS/OFF switches to OFF.

2 Verify that the output of the signal source is not connected to the protective ground and that a signal exceeding 500Vp-p is not connected between the (+) and (-) or GND and that the signal is not a high-frequency signal.

3 For normal signal sources, make connections as shown in Fig. 3-3 (the shorting bar is not removed).

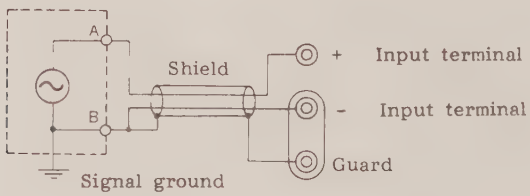


Fig. 3-3

4 For signal sources having a bias, connection should be made as shown in Fig. 3-4 so that the (-) is used as the signal connection having a low impedance with respect to ground (the shorting bar is removed).

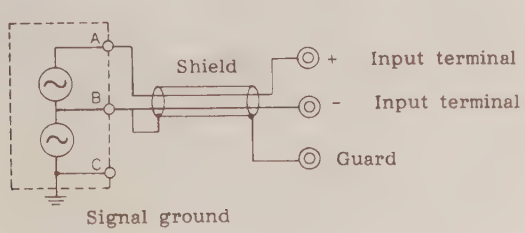


Fig. 3-4

5 For differential-output signal sources, connection should be made as shown in Fig. 3-5 (the shorting bar is removed).

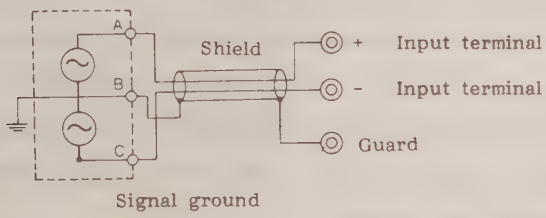


Fig. 3-5

CAUTION

1. When measuring low-level signal sources having a high output impedance, depending upon the ground point of the guard, the noise elimination effect may vary. For this reason, various grounding arrangements should be tried.

2. The input lead plug-in direction should always be made as shown in Fig. 3-1. If this is reversed, the signal source may be damaged.

3.3 Operating Attitude and Use of the V/H Switch

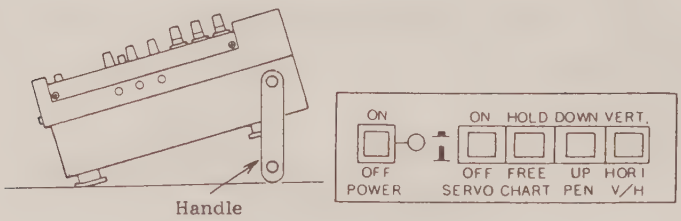


Fig. 3-6

This recorder may be set up for either horizontal or vertical operation. When using it in a horizontal attitude, set the V/H switch to HORI, and when using it in the vertical attitude, set this switch to VERT.

When the handle is used as shown in Fig. 3-6 as a stand, the switch should be set to HORI.

When using the WX2400-2 (2-ch type) in a vertical attitude, turn the pen arm cover pen pressure setting screw 90° as shown below.

3.4 Pen Mounting and Pen Pressure Setting Screws

To mount the pen, set the SERVO switch to OFF and following the procedure below.

1 Move the pen head to roughly the center of the recording area.

2 Remove the pen cap and fit the knob at the bottom of the pen into the hole in the pen head, pressing it in with both hands (refer to Fig. 3-7).

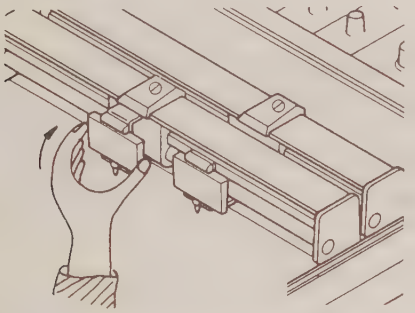


Fig. 3-7

3 Move the pen up and down manually to check if it is sliding properly.

4 On two-channel machines, the pen head with the long left side is the Y_2 channel and the inner short side is the Y_1 channel. Mount a red pen on the Y_1 channel and a black pen on the Y_2 channel.

The WX2400-2 (2-pen type) has the pen pressure setting screws as shown in Fig. 3-7.

3.5 Mounting Recording Paper

To mount recording paper, set the POWER switch to ON and the SERVO CHART switches to OFF. Next, follow the procedure below.

1 Move the Y bar to the left edge.

2 Taking care that the pen tip does not touch the recording paper, place the recording paper on the writing panel from the top left (refer to Fig. 3-8).

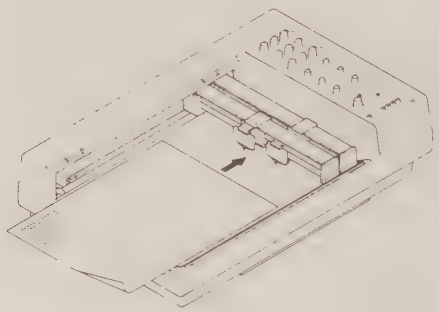


Fig. 3-8

3 Align the paper with the left edge of the scale on the inside of the two bright points on the writing panel (refer to Fig. 3-9).

Fig. 3-9

4 Align the X-axis scale and two bright points on the writing panel.

5 Set the CHART switch to ON to hold the paper.

6 Verify that the entire recording paper is being held to the writing panel. (Rub the surface of the paper with the hand to check that it is not raised off the writing panel.)

To remove the recording paper, set the CHART switch to OFF. Set the SERVO to OFF. Move the Y bar to the right and, taking care that the pen does not contact and soil the recording paper, remove the paper in the upper left direction.

3.6 Points to Remember When Preparing the Recorder

1 When connecting the power supply, always make connection to the protective ground terminal first.

2 When making connections to other devices, the input cable shield lead may not be used as the protective ground lead. The protective ground lead should always be provided separately.

3 After using, remove the pen(s) and cap securely. Also, striking or rubbing the pen tips will cause clogging. If a pen is no longer able to create proper recordings, replace with a new pen.

4 Avoid using paper that is excessively curly. If the recording paper floats off of the writing panel surface, the Y bar movement may cause the recording paper to move and writing may occur even with the pen in the up position.

4. MEASUREMENT AND RECORDING

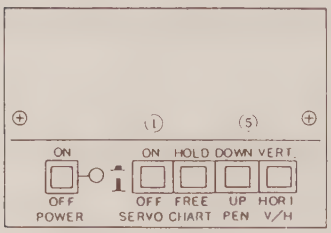


Fig. 4-1

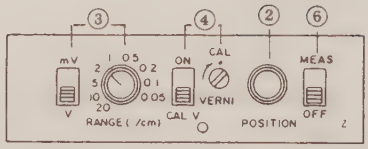


Fig. 4-2

4.1 Inspection Before Beginning Measurement

Before mounting the pen(s) and recording paper, check the following points.

1 The SERVO switch (control panel) should be OFF.

2 The PEN switch (control panel) should be UP.

3 The MEAS/OFF switch (preamplifier) should be OFF.

4.2 Preparation Immediately Before Measurement

After making proper connections to power supply and signal leads as described in previous sections, mount the pen(s) and recording paper.

4.3 Starting Measurement

Measurement and recording are started by following the procedure below.

1 SERVO ON

This operation starts the servo towards the balance point at full speed and stops it when balance is reached.

2 POSITION Setting

Turn the preamplifier POSITION adjustment to move the pen to the desired starting position.

3 Sensitivity Setting

Set the preamplifier mV/V switch and RANGE switch to the proper sensitivity, based on the level of the input signal.

4 Fine Adjustment of Sensitivity

Turn the VERNI trimmer to fine adjust the sensitivity, while observing the servo system deflection.

5 PEN Down

After checking the POSITION and sensitivity settings, operate the PEN UP/DOWN switch to lower the pen.

6 Starting Measurement

Set the preamplifier MEAS/OFF switch to MEAS to begin measurement.

4.4 Precautions in Making Measurements and Recordings

Care should be taken with the following points when making measurements and recordings.

1 If the level of the input signal is not known, start the sensitivity setting at a low sensitivity and adjust upward while observing the pen deflection.

2 During measurement, if abnormal servo system noise is detected or the pen lift mechanism does not operate as expected, set the MEAS/OFF switch and SERVO ON/OFF switch immediately to OFF and recheck connections and switch settings. (Note that if the SERVO switch is OFF or the CHART switch is FREE, the pen will not be lowered.)

4.5 Using External Signals

When using external signals to control this recorder, solder only the required signal leads to the external signal connector provided as an accessory, using the signal assignments shown in Fig. 1-11 as a guide.

As shown in Fig. 4-3, the connector is held together with screws 1 and 2 and removing the screws allows disassembly. After inserting the connector, tighten screw 3 and verify that the connector is mated properly.

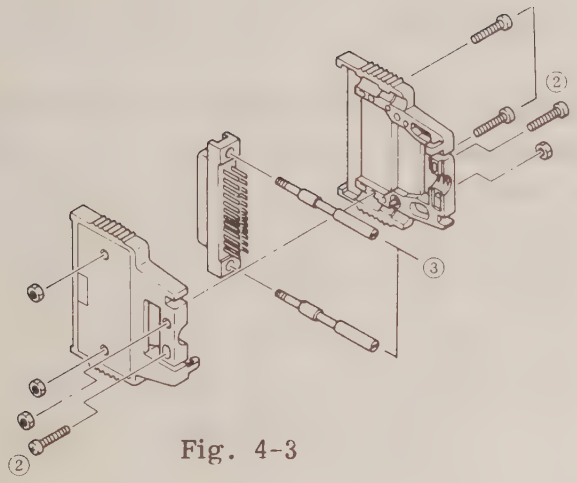


Fig. 4-3

4.5.1 Input Signal Leads

The analog signals applied to the external connector are input to the preamplifier. To avoid the introduction of noise, the following precautions are required.

1 A floating ground input should be used, with the (-) side used as the low impedance, low-potential side with respect to the signal source protective ground.

2 The (+) and (-) leads should follow the same path and care should be taken in dressing these leads so that induction of signals from other signal leads is reduced. A two-conductor shielded cable should be used.

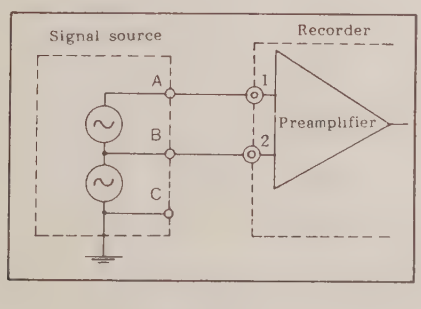


Fig. 4-4

4.5.2 Zero Point Setting

To set the zero point externally, a 10kΩ potentiometer should be connected as shown in Fig. 4-5, taking the following precautions when making connections.

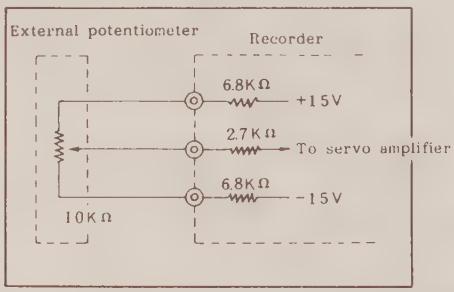


Fig. 4-5

1 The power supply voltage supplied to the potentiometer is separate for each axis, so that one potentiometer is required for each axis.

2 The zero point range and linearity will depend upon the internal resistance of the potentiometer. A 10kΩ or so precision multi-turn potentiometer with good temperature characteristics should be used.

4.5.3 Control Signals

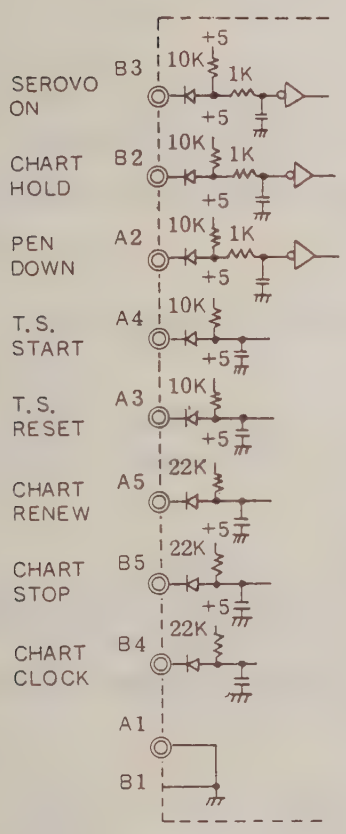


Fig. 4-6

External control signals, with the exception of the clock signal used to control the paper feed mechanism, may either be contact closures or TTL low-level (high=5V, low=0 ∿ 0.5V) signals. The following points should be observed.

1 Connector pin A1 or B1 should be used as the ground side. This pin is connected to the recorder's protective ground terminal.

2 The internal circuit configuration is as shown in Fig. 4-6, so that it is possible to operate these inputs using an open-collector output.

3 Care should be taken that the input voltage neither goes negative nor greatly exceeds +5V.

4 When using the paper feed mechanism, connect a clock signal, observing the precautions described in the section on the paper feed mechanism at the end of this document.

5. MAINTENANCE AND TROUBLESHOOTING

5.1 Handling Trouble

Table 5-1 lists symptoms for corrections and failures. Troubleshooting should be done using this table as a guide. If questions or problems arise, contact your local sales or service representative.

5.2 Precautions to Observe When Performing Maintenance

1 Take care to observe the precautions listed in the beginning of this document with respect to installation location.

2 Dirt on the outer case and lighted panel should be removed using either a blower brush or a cloth wetted with alcohol or a similar cleanser. Never use thinner or other organic solvents.

3 When replacing fuses, always use a new fuse of the proper rating. Never use old (repaired) fuses or short the fuse box terminals.

4 Repair and adjustment which require that the outer case (including rear cover) be opened should be left up to your service representative. When requesting repair, please be sure to make as detailed a report of the failure symptoms as possible. (This applies to repairs and adjustments listed in Table 5-1 as well.)

Failure symptom		Cause	Correction
No power	Display does not light	Bad line power, cable, fuse, etc.	First check the fuse and then use a meter to check the power supply. If the cause is not determinable, request service.
	No response to control panel switches		
Servo does not start or starts too slowly		Foreign matter in the servo mechanism.	Turn power off, check the sliding mechanism, and remove the foreign matter.
		Bad servo circuit or servo amplifier.	Request service.
Improper paper hold		Recording paper is significantly different from the standard type.	Use the standard type recording paper.
		Dirty writing panel.	Wipe the writing panel using a cleaner.
		Bad electrostatic paper hold supply.	Request service.
Improper pen up/down		Improper pen mounting.	Carefully check the mounting condition.
		Foreign matter on the pen head.	Move the pen head up and down manually and remove the foreign matter.
		Bad pen head circuit.	Request service.
Unclear recording		Pen has reached its usable lifetime.	Replace pen with new unit.
		Improper recording paper.	Replace with proper recording paper.
No response when POSITION is turned	Narrow response range	Excessively large signal is being input.	Turn MEAS/OFF switch to OFF and check.
	No response	Bad preamplifier.	Switch preamplifiers.
	Pins at both ends and does not move	Bad servo amplifier.	Request service.
Bad range accuracy		Improper calibration of preamplifier.	Request recalibration of preamplifier.
With MEAS/OFF at MEAS	Over fullscale	Input is excessively large.	Switch the mV/V and RANGE to lower the sensitivity.
	Servo jitter	Bad input - connection.	Check input cable connection.
	Recording shakey	Input has large high-frequency components.	Check input waveform using another method.
	Improper response to squarewave input	Improper adjustment of servo system.	Request readjustment.

6. TIME SWEEP

To enable X-T or Y-T recording using an X-Y recorder, the time sweep is a module which applies an accurately rising voltage used as either the X-axis or Y-axis signal. The time sweep operating panel is shown in Fig. 6-1. This panel adjoins the control switch panel.

For the WX2400-2 Two-Channel Recorder, time sweep of the X axis and Y_1 axis is possible, with the Y_3 being unrelated to the time sweep.

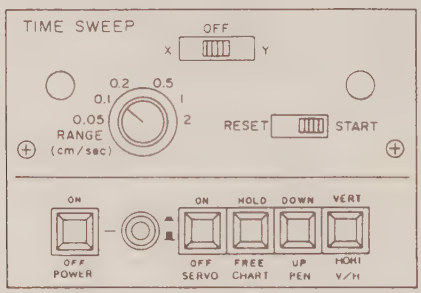


Fig. 6-1

6.1 Names and Functions of Parts

X-OFF-Y Switch

This switch is used to select the axis to the time swept. When set to OFF, the recorder operates as a conventional X-Y recorder.

RANGE Switch

This switch is used to select the speed of the time sweep. The setting of this switch determines the speed of the X axis (carriage) or Y axis (pen head) in the positive (or right/upward) direction.

RESET/START Switch

When set to START, the increase of the time sweep voltage begins. If the SERVO switch is ON and the pen switch is DOWN, this voltage will cause the pen to be lowered and, depending upon the setting of the X-OFF-Y switch, one of the axes will begin time sweeping. If the X axis was selected, when the pen reaches the right edge, a limiter operates and the pen is automatically raised and returns to the starting position.

6.2 Using the Time Sweep

6.2.1 Use as an X-T Recorder

1 First, set the RESET/START switch to RESET.

2 Set the X-OFF-Y switch to X.

3 Set the RANGE switch to the desired sweep speed.

4 Turn the preamplifier POSITION control to move the pen to the desired starting position (SERVO switch ON).

5 Set the RESET/START switch to START. The X-axis time sweep will begin immediately.

6.2.2 Use as an Y-T Recorder

Except for the setting of the X-OFF-Y switch to Y, operation is exactly the same as for X-T recording, described above.

6.2.3 Precautions for Use

1 The time sweep voltage is added to the preamplifier output and input to the servo amplifier. If time sweep only is to be used, the preamplifier MEAS/OFF switch should be set to OFF.

2 When setting the starting position, if the initial voltage exceeds the recording range, even if the RESET/START switch is set to START, the servo system will not move for some period of time, thus causing erroneous reading of recording data.

3 When the X-OFF-Y switch is set to X or Y, even if the PEN switch is set to DOWN, if the RESET/START switch is in the RESET position, the pen will not lower. The pen will be lowered when the START position is selected.

7. FUNCTIONAL EXPANSION

Fig. 7-1 showns the WX2400 with the paper feed mechanism installed, and Fig. 7-2 shows photographs of the preamplifier units available.

WX2400 Series X-Y Recorders include the WX2400-1 with one Y-axis channel and the WX2400-2 with a two-channel Y axis. Either of these recorders may be fitted with a paper feed mechanism as an option.

Also, 16 types of preamplifier units (see Fig. 7-2) are available and, with certain exceptions, these can be exchanged freely.

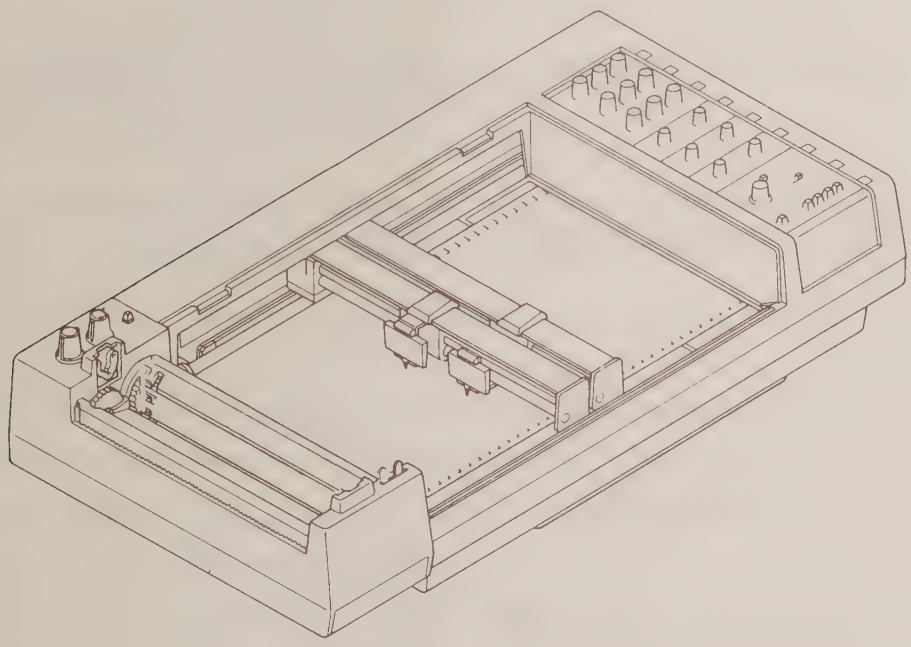


Fig. 7-1

Fig. 7-2

7.1 Exchanging Preamplifiers

1 First set the POWER switch to OFF.

2 Remove the four screws holding the top cover onto the recorder and remove the top cover from the recorder (Fig. 7-3).

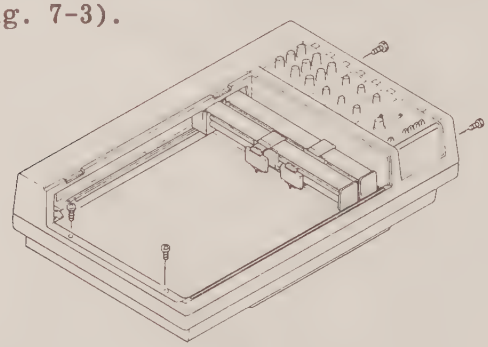


Fig. 7-3

3 Remove the single preamplifier mounting screw (Fig. 7-4).

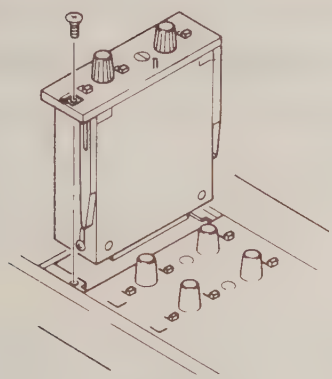


Fig. 7-4

4 Raise the preamplifier cover from the recorder side using a flatblade screwdriver or other similar tool.

5 Replace with the desired preamplifier, using the reverse of the above procedure.

6 Set the MEAS/OFF switch to OFF, the POWER switch to ON, and check operation by turning the POSITION adjustment.

CAUTION

1. When adding preamplifiers which have a built in conditioner (type T, K, T-1, K-1, J-1, E-1, (PR-1), TH (thermistor), etc., temperature units), a partial modification of the input panel is required.

2. When exchanging preamplifiers, always turn the power supply off before this operation.

7.2 Rack Mounting

This recorder can be mounted, as described below, in a standard JIS rack (mounting width = 460mm), enabling use in a vertical attitude.

7.2.1 Mounting Method

Procedure Here

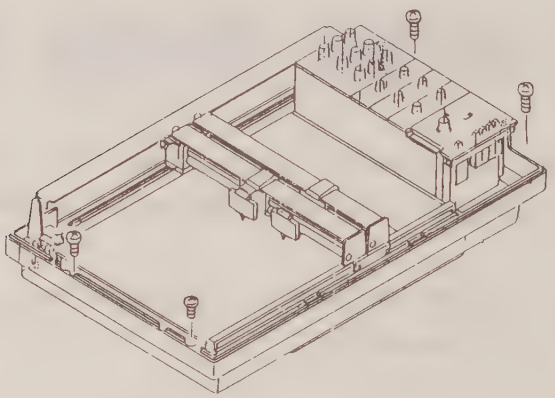


Fig. 7-5

CAUTION

1. When adding the paper feed mechanism or preamplifiers such as temperature units which use conditioners, these operations are to be performed at the factory. Contact your sales representative for details.

2. Normal preamplifiers, however, can be easily exchanged at the user location. If additional preamplifiers are required, verify whether modification of the recorder is required before ordering.

3. The rack which is used for vertical attitude recording is optional. Please specify this when ordering.

4. Pens, recording paper, and external connector are always in stock. Contact your service station.

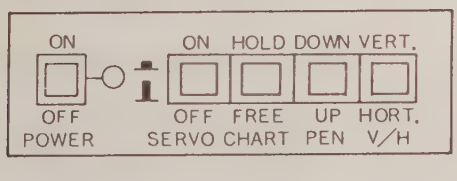


Fig. 7-6

8. SPECIFICATIONS (Configuration)

8.1 Recorder Specifications (Table 8-1)

Model	WX2400-1 (1 Pen)	WX2400-2 (2 Pens)
Recording area	A4 Size (250 x 180mm)	
Recording paper holding method	Electrostatic attraction	
Pen	Disposable fiber-tip pen	
Circuit type	DC Servo	
Input type	Floating ground with guard	
Input resistance	1MΩ*	
Allowable signal source resistance	10kΩ or less*	
Accuracy	±0.25% of fullscale* (Including deadband)	
Deadband	±0.1% of fullscale	
Common mode rejection ratio	DC 150dB and AC 140dB or better at maximum sensitivity	
Position adjustment	Pen position may be adjusted to any location within the fullscale range*	
Sensitivity adjustment	2.5 times*	
Maximum allowable input voltage	500VDC (including common-mode voltage)	
Maximum pen speed	X=1.5m/s, Y_1=1.5m/s	X=0.8m/s, Y_1, Y_2=1.5m/s
Max pen acceleration	X=3G, Y_1=4G	X=2G, Y_1, Y_2=4G
Pen lift response	10Hz	1Hz
Pen busy time	20ms	300ms

Model	WX2400-1 (1 Pen)	WX2400-2 (2 Pens)
Time sweep	Refer to Table 8-2	
Outer dimensions	482 x 310 x 124mm	
Weight	10.5kg	11.5kg
Power consumption	Balanced: 20VA	Balanced: 37VA
	Unbalanced: 105VA	Unbalanced: 130VA
Operating environment	0 ∿ 45°C, 30 ∿ 85% (RH)	
Power supply	100VAC ±10%, 50/60Hz, (or 115, 200, 220, 240VAC)	
Accessories	Refer to Table 8-3	
Option Recording paper unit	Refer to Table10-1	
Preamplifier	Refer to Chapter 9	
Rack	Refer to Fig. 7-5	

Note: Items marked "*" apply when the AZ2400 DC amplifier is installed as the preamplifier.

8.2 Time Sweep Specifications (Table 8-2)

Method	Precision analog voltage integration
Ranges	0.05, 0.1, 0.2, 0.5, 1, 2, cm/s (both X and Y axes)
Feed speed accuracy	±3% of fullscale
Linearity	±0.5%
Control operation	X/OFF/Y Switching, RESET/START

8.3 Accessories (Table 8-3)

Name	Model	Description	
		WX2400-1	WX2400-2
Power cable	VM1165B-VM1172	2-Conductor vinyl insulated power cable with 3-prong connector.	
Fuse	SM-1101-2A	100VAC: 2A x 2 200VAC: 1A x 2	
External signal connector	FCM-361J032-AG	Type FCN-361J032-AG 32-pin connector x 1	
Input signal cable	With 3-pin plug	2-Conductor shielded cable x 2	2-Conductor shielded cable x 3
Pens	1 Pen Kx106-RD 2 Pen Kx106-BK	Red (hard fiber pen) x 5	Red (hard fiber pen) 5 Pens each Black (hard fiber pen)
Recording paper	PL-121	A4 Size graph paper (1 pad)	
Other		Instruction manual (this document), vinyl cover, accessory storage bag	

8.4 Configuration (Table 8-4)

Item	Standard	W/Conditioner	W/Paper feed	Direct recorder input
Recorder mainframe	1	1	1	1
Input panel	1		1	
Conditioner		No. of channels		
Preamplifier	No. of channels	No. of channels	No. of channels	
Time sweep	1	1		
Control panel	1	1	1	1
Recording paper feed unit			1	
Added accessories			1 Roll	

(Notes)

1. Holes which remain empty because certain features have not been installed are covered by blank panels.

2. Versions having two or more options built in are distinguished by letter suffixes at the end of the model number.

8.5 Ordering Quantities for Consumable Items (Table 8-5)

Recording Paper

Product No.	Type	Ordering qty.	Specifications or applicable models
13-1	PL121	20 pads	A4 Size coated paper (50 sheets per pad) 1mm grid
13-2	SP279	10 rolls	A4 or equivalent measurement paper (20m per roll) 1mm grid
13-3	SP323	10 pads	A4 Size measurement paper (100 sheets per pad) 1mm grid

Recording Pens

Product No.	Type	Ordering qty.	Specifications or applicable models
13-4	KX106-RD	2 sets	Fiber-tip pens (5 pens per set) Red (for 1-pen recorders)
13-5	KX106-BK	2 sets	Fiber-tip pens (5 pens per set) Black (for 2-pen recorders)

9. PREAMPLIFIER UNITS

9.1 Voltage Measurement

Item \ Type	E	Z	L
Input mode	Floating and guarded signal pair		
Measuring range (/cm)	0.005, 0.01, 0.02, 0.05, 0.1, 0.2, 0.5, 1, 2 mV & V	0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20 mV & V	0.5, 1, 2, 5, 10, 20, 50, 100 mV (x1, x100)
Switching accuracy: (basic range: 0.1V)	±0.25%		±0.45%
Input resistance	1 MΩ (constant)		
Allowable signal source resistance	1 kΩ or less		
Calibration voltage	Regulated voltage supply produces 10 cm of pen deflection		
Sensitivity adjustment	Continuously variable over the whole range		
Position adjustment	130% of full scale	-300 ~ +300% of full scale continuously variable	130% of full scale
Bias voltage		Manually biased	
Input filter characteristics		Switch selectable: OFF, -20dB, -40dB	
Common mode rejection ratio	AC: 130dB (50/60 Hz) DC: 150dB	AC: 140dB (50/60 Hz) DC: 150dB	AC: 120dB (50/60 Hz) DC: 140dB
Maximum allowable input voltage	500 V DC (including common mode voltage)		

9.2 Temperature Measurement

Item \ Type		T-1	K-1	PR-1	J-1	E-1	PT	TH	TL
Input sensor		CC type thermo-couple	CA type thermo-couple	PR type thermo-couple	IC type thermo-couple	CRC type thermo-couple	Platinum resistance thermo-meter	Thermistor	
Measuring ranges		-50~+50°C 0~+150°C 0~+300°C	0~+300°C 0~+600°C 0~+800°C 0~+1200°C	+800~ +1200°C +800~ +1400°C +800~ +1600°C	0~+100°C 0~ +200°C 0~+400°C 0~+600°C		-50~0°C 0~+50°C 0~+100°C 0~+200°C	0~+100°C	-50~+50°C
Accuracy	Linearization	±1% /FS					±0.5% /FS	±0.3% /FS	
	Room temperature compensation	±1°C (at 13 ~ 33°C), ±2°C (at 0 ~ 45°C)							
Zero set		-10~+60% /FS	-10~+30% /FS				±20% /FS	fixed	
Response time		0.1 sec./full scale						4 sec./full scale	
Common mode rejection ratio		AC: 120dB (50/60 Hz)							

9.3 Signal Conversion

Item \ Type	KL (Log)	KF (F/V)	KD (AC/DC)	KD-3 (AC/DC)	KC (current)
Input type	Direct or Alternating current, 10 Hz to 20 kHz	Alternating current, at least 0.5V peak to peak	Sine wave, 10 Hz to 100 kHz		Direct current
Input mode	Floating and guarded signal pair				
Measuring range (/FS)	0.5V: 0.5mV~0.5V 5V: 5mV~5V 50V: 50mV~50V 500V: 0.5V~500V	20, 50, 100, 200, 500 Hz 1, 2, 5, 10 kHz	0.01, 0.02, 0.05, 0.1 0.2, 0.5, 1, 2 x1V and x100V	0.01, 0.02, 0.05, 0.1 0.2, 0.5, 1, 3 x1V and x100V	0~10 mA 0~20 mA 4~20 mA
Input resistance	1 MΩ//10pF	100 kΩ	1 MΩ//10pF		10 Ω
Calibration voltage	0.5, 50V range: 0dB 5, 500V range: -20dB	10 kHz	Full scale for each range		
Zero set	±20% of full scale	50% of full scale	120% of full scale	130% of full scale	-10~+30% of full scale
Linearity	DC: ±0.5dB/FS AC: ±1dB/FS	±0.5%/full scale			
Drift (ripple)	0.3dB/10°C	±1.5%/FS (20 Hz)	0.3%/10°C		0.5%/10°C
Response time	Rising: 0.1 sec/20dB Falling: 1 sec/40dB 3 sec/60dB	0.6 sec./full scale	0.2 sec./full scale		
Maximum allowable input	500 V DC	200 V (P-P)	200 V (RMS)	300 V (RMS)	150 mA

9.4 Special Notes

1 Requirements for Modifying the Input Panel

When using temperature units other than type TL or the AE2400, the input panel changes to accommodate the required conditioner.

2 Fullscale Definition

Fullscale is defined as the deflection width of the X axis of the recording paper (250mm).

3 Sensitivity Indication

The sensitivity per unit cm or per 250mm is indicated for voltage units or other units, respectively.

4 When using the Y axis, the measurement range is indicated in the conversion table that follows in Section 9.5.

9.5 Amplifier Unit Range Conversion Tables

Plug-in type	Amp unit display range	Converted value	
		Measurement units	Measurement range
CC-1 (T-1)	-50 ∿ 50°C	X: -50 ∿ 50°C Y: -50 ∿ 22°C	4°C/cm
	0 ∿ 150°C	X: 0 ∿ 150°C Y: 0 ∿ 108°C	6°C/cm
	0 ∿ 300°C	X: 0 ∿ 300°C Y: 0 ∿ 216°C	12°C/cm
CA-1 (K-1)	0 ∿ 300°C	X: 0 ∿ 300°C Y: 0 ∿ 216°C	12°C/cm
	0 ∿ 600°C	X: 0 ∿ 600°C Y: 0 ∿ 432°C	24°C/cm
	0 ∿ 800°C	X: 0 ∿ 800°C Y: 0 ∿ 576°C	32°C/cm
	0 ∿ 1200°C	X: 0 ∿ 1200°C Y: 0 ∿ 864°C	48°C/cm
PR-1	800 ∿ 1200°C	X: 800 ∿ 1200°C Y: 800 ∿ 1088°C	16°C/cm
	800 ∿ 1400°C	X: 800 ∿ 1400°C Y 800 ∿ 1232°C	24°C/cm
	800 ∿ 1600°C	X: 800 ∿ 1600°C Y: 800 ∿ 1376°C	32°C/cm

Plug-in type	Amp unit display range	Converted value	
		Measurement units	Measurement range
IC-1 (J-1) & CR-1 (E-1)	0 ∿ 100°C	X: 0 ∿ 100°C Y: 0 ∿ 72°C	4°C/cm
	0 ∿ 200°C	X: 0 ∿ 200°C Y: 0 ∿ 144°C	8°C/cm
	0 ∿ 400°C	X: 0 ∿ 400°C Y: 0 ∿ 288°C	16°C/cm
	0 ∿ 600°C	X: 0 ∿ 600°C Y: 0 ∿ 432°C	24°C/c/
TH	0 ∿ 100°C	X: 0 ∿ 100°C Y: 14 ∿ 86°C	4°C/cm
TL	-50 ∿ 50°C	X: -50 ∿ 50°C Y: -36 ∿ 36°C	4°C/cm
KC	0 ∿ 10mA	X: 0 ∿ 10mA Y: 0 ∿ 7.2mA	0.4mA/cm
	0 ∿ 20mA	X: 0 ∿ 20mA Y: 0 ∿ 14.4mA	0.8mA/cm
	4 ∿ 20mA	X: 4 ∿ 20mA Y: 4 ∿ 15.52mA	0.64mA/cm

Plug-in type	Amp unit display range	Converted value Measurement units
KD-3	0.01 0.02 0.05 0.1 0.2 0.5 1 3	0.4 0.8 2 4 8 20 40 120
	x1V x100V	xmV/cm x100mV/cm
KD	0.01 0.02 0.05 0.1 0.2 0.5 1 2	0.4 0.8 2 4 8 20 40 80
	x1V x100V	xmV/cm x100mV/cm
KF	20 50 100 Hz 200 500 1 2 kHz 5 10	0.8 2 4 8 20 Hz/cm 40 80 200 400
KL	0.5V	X: 0.5mV ∿ 0.5V Y: 3.46mV ∿ 0.5V
	5V	X: 5mV ∿ 5V Y: 34.6mV ∿ 5V
	50V	X: 50mV ∿ 50V Y: 346mV ∿ 50V
	500V	X: 0.5mV ∿ 500V Y: 3.46mV ∿ 500V
	-60dB/FS	-2.4dB/cm

10. RECORDING PAPER FEED MECHANISM (TA2400 Optional)

10.1 Names and Functions of Parts

By installing the TA2400 recording paper feed mechanism onto a WX2400 A4-size X-Y recorder, if SP-279 roll paper is mounted, the X-axis can be used as the time axis to enable Y-T recording and automatic feed (RENEW function) can be used to update recording frames. Fig. 1 illustrates the operating section for this paper feed mechanism.

(Note)
As special tool are required to install this paper feed mechanism, it may not be installed in the field.

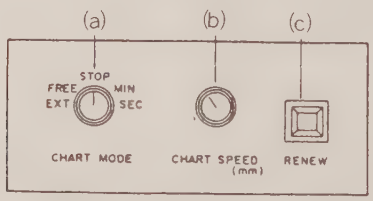


Fig. 10-1

10.1.1 CHART SPEED Control

This is the range setting for the recording paper feed speed.

10.1.2 FEED MODE Switch

This switch controls the recording paper feed mode, as follows.

1 SEC: When selected, the paper feed speed is taken as the CHART SPEED dial setting in unit of /s.

2 MIN: When selected, the paper feed speed is taken as the CHART SPEED dial setting in unit of /min.

3 STOP: When selected, recording paper feed stops. RENEW operations are performed in this position.

4 FREE: This setting position is used when replacing recording paper. Since the motor is not excited in this position, the sprocket may be turned manually.

5 EXT: In this position, paper feed is controlled by the clock pulse applied to the external connector. In this mode EXT RENEW is also possible.

10.1.3 RENEW Pushbutton

If the FEED MODE switch is set to STOP, when this switch is pressed, the pen automatically rises. The recording paper will feed for 288mm at a speed of 5cm/s and stop. If pressed once more while feed is continuing, the RENEW operation is stopped and the paper is stopped in the position at that point.

10.2 Recording Paper Feed Operating Section and Control Panel

The dials and switches of the recording paper feed operating section are related to the recorder mainframe control panel switches in the following manner.

1 If the CHART-HOLD/FREE switch on the mainframe control panel is set to HOLD, feed operation of the recorder paper feed mechanism will be as if the SPEED MODE switch of that mechanism was set to STOP, regardless of the actual setting. RENEW operation will also stop.

2 When the recording paper feed mechanism is installed, pen UP/DOWN control is possible using the CHART FREE. However, when the RENEW switch is pressed and paper is moving, the pen will not be lowered, even if PEN DOWN is enabled. The pen will lower when the paper stops.

10.3 Recording Paper

Roll paper (S-P279) is used as shown in Fig. 10-2.

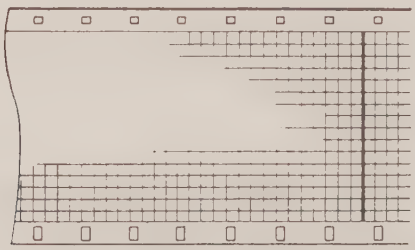


Fig. 10-2

10.4 Mounting of Roll Paper

10.4.1 Mounting

1 Set the CHART-HOLD/FREE switch on the control panel to FREE.

2 Set the CHART MODE switch on the operating section to FREE.

3 Open the stocker and insert the roll of paper with the elongated hole side towards the top. (Refer to Fig. 10-3 and press the spring at the top.)

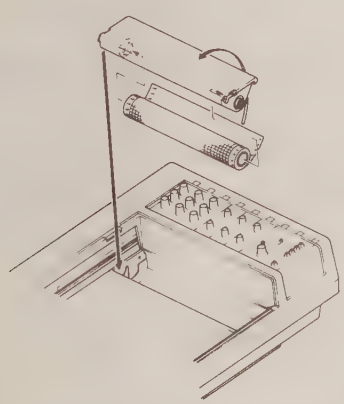


Fig. 10-3

4 Pull the recording paper edge along the writing panel and close the stocker. Push in until this locks.

10.4.2 Using the Takeup Spool to Take Up the Paper

1 To use the takeup spool, install the takeup spool so that the gear side is towards to the top and ensure that the gear meshes.

2 As shown in Fig. 10-4, lower the paper retaining lever and pass the recording paper under the sprocket and wind around the takeup spool.

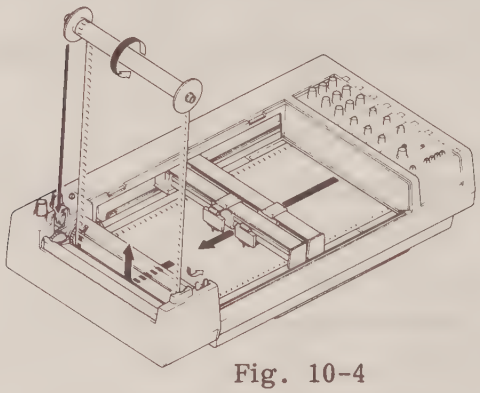


Fig. 10-4

3 Engage the sprocket and recording paper holes and raise the paper retaining lever.

4 Turn the sprocket shaft clockwise and align the recording paper scale with the writing panel alignment lamps.

10.4.3 Removing the Recording Paper

1 After recording is completed, to remove the recording paper, do not take up the recording paper onto the takeup spool but rather pass the cutting knife under the paper.

2 Turn the sprocket shaft and align the recording paper scale.

3 When cutting away the recording paper, use the knife as shown in Fig. 10-5.

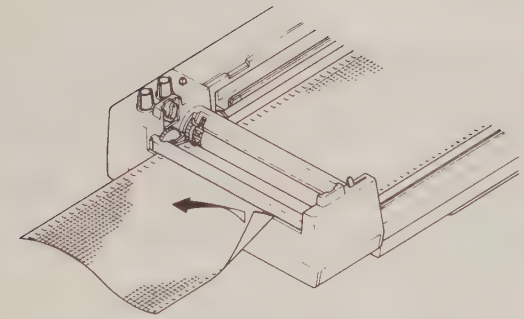


Fig. 10-5

10.5 Precautions for Use

1 Manual Feed of Recording Paper

To set up the recording paper by turning the sprocket by hand, set the FEED MODE switch to the FREE position. In other positions, the feed motor will be held magnetically and is not movable.

2 External Drive of Recording Paper

To drive the recording paper feed mechanism using an external signal, a drive pulse signal is applied at the external connector of the recorder mainframe and the FEED MODE switch is set to the EXT position. If not in this position, paper feed will not be possible. The external signal frequency should be a maximum of 2000pps (corresponding to 5cm/s).

3 RENEW

If, during a RENEW operation, the RENEW pushbutton is pressed once again, the RENEW operation will terminate. Therefore, if this pushbutton is not pressed sharply, the recorder will sense that the RENEW button has been pressed twice and unstable operation will result.

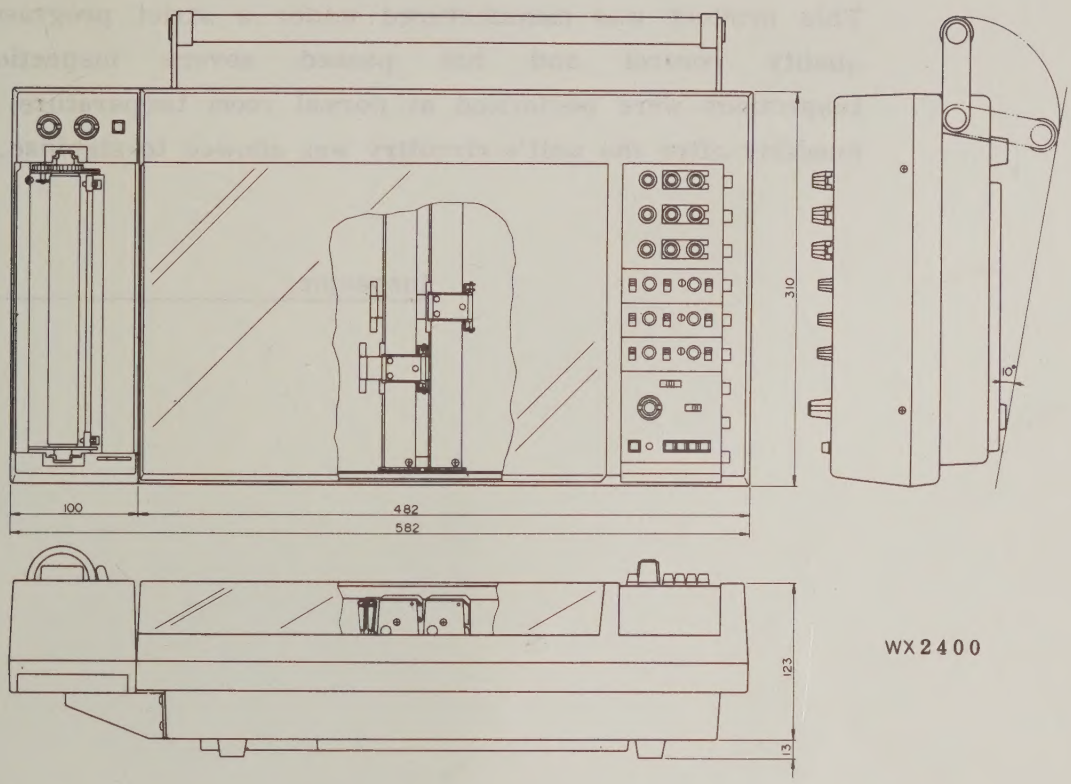
4 End of Recording Paper

The last approximately 1m of the recording paper is printed with a red mark. When this red mark appears, a new roll of paper should be installed.

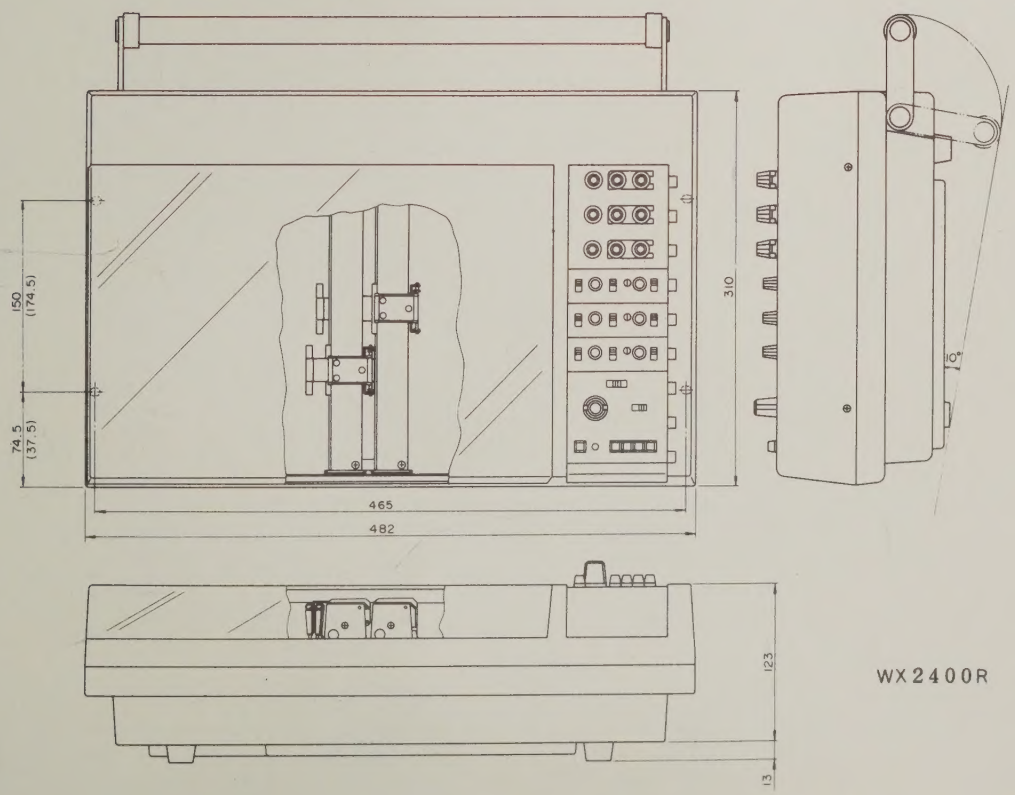
10.6 Paper Feed Mechanism Specifications

Item	Specification
Feed speeds	14 Steps: 0.05, 0.1, 0.2, 0.5, 1, 2, 5cm/s & min
Feed accuracy	±1%
RENEW (EXT RENEW)	One sheet: 288mm feed speed of 5cm/s
External feed	Feed speed 0 ∿ 5cm/s (Input as a TTL level 0 ∿ 2000pulse/s signal at the remote connector)
Drive method	Sprocket feed using a stepping motor. 0.025mm/pulse, vernier drive system
Remote functions	Paper feed using an external signal Paper feed START/STOP EXT RENEW (1-Sheet feed using an external signal)

11. OUTER VIEWS



WX2400



WX2400R

12. INSPECTION CERTIFICATION

This product was manufactured under a strict program of quality control and has passed severe inspections. Inspections were performed at normal room temperature and humidity after the unit's circuitry was allowed to stabilize.

Inspector: _____

PLEASE NOTE

FAILURE TO RETURN THIS MANUAL WILL RESULT IN A MINIMUM BILLING CHARGE OF **$50.00.**

PLEASE INCLUDE MANUAL AND ACCESSORIES WHEN RETURNING EQUIPMENT

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